



USE OF ELECTRODES TO DETERMINE pH AND ION CONCENTRATIONS IN SOLUTIONS

PROCEDURE ID: YMP-LBNL-TIP/AFT 8.0

REV.1, MOD. 0

EFFECTIVE: 08/25/2000

1. PURPOSE

This Technical Implementing Procedure (TIP) describes the use of pH electrode and/or ion-selective electrodes (ISEs) to measure pH and/or aqueous ion concentrations in liquid samples at Lawrence Berkeley National Laboratory (LBNL) for supporting the Yucca Mountain Site Characterization Project (YMP).

2. SCOPE

This procedure applies to all YMP-LBNL personnel (or contractor personnel following LBNL procedures) involved in the use of electrodes to measure pH and/or concentrations of constituents in solutions, except when other procedures (e.g., YMP-LBNL-TIP/TT 13.0 for pH measurement) are in effect, for YMP activities subject to Quality Assurance Requirements and Description (QARD), DOE/RW-0333P. Prior to conducting work described in Section 3 of this procedure, personnel performing measurements, require training to this procedure.

All technical activities, data collected using this procedure, and any instrument calibrations shall be in accordance with this TIP and in full compliance with YMP Administrative Procedure (YAP)-12.3Q, *Control of Measuring and Test Equipment and Calibration Standards*. All documentation resulting from actions taken under this TIP will be recorded in the scientific notebook and/or the Equipment Logbook (which are controlled as a supplemental record to the scientific notebook) as described in the Office of Civilian Radioactive Waste Management (OCRWM) Administrative Procedure (AP)-SIII.1Q, *Scientific Notebooks*. Documented control of physical samples shall be in accordance with YMP-LBNL-QIP-SII.0, *Documenting Sample Control*.

If this procedure cannot be implemented as written, YMP-LBNL personnel shall notify the responsible Principal Investigator (PI) or designee. If it is determined that a portion of the work cannot be accomplished as described in this TIP, or would produce undesirable results, that portion of the work shall be stopped and not resumed until this procedure is modified per YMP-LBNL-QIP-5.2, *Preparing Development Plans & Quality /Technical Implementing Procedures*.

If the responsible PI or designee determines that a modification or a revision to the TIP would cause an unreasonable delay in proceeding with the task, then an expedited change to the procedure, including documentation of deviation from the approved procedure, can be made according to YMP-LBNL-QIP-5.2. Such changes are subject to review, usually after the task has proceeded, and thus work performed under TIPs with expedited changes is done at risk of future invalidation.

Employees may use a controlled electronic or hard copy of this procedure; however, employees are responsible for assuring that the correct revision of this procedure is used. When this procedure becomes obsolete or superseded, it must be destroyed or marked "superseded" to ensure that this document is not used to perform work in accordance with YMP-LBNL-QIP-6.0, *Document Control*.

3. PROCEDURE

3.1 Principle

An ion-selective electrode (ISE), when used in conjunction with a reference electrode and a pH/ISE meter, gives a voltage reading that varies linearly with the logarithm of the ion activity in solution. Ion activities can be measured by a number of different techniques, and this TIP is prepared for the direct calibration technique (see Section 3.4.4). The ISE responds to the activity of ions, not their concentration. If the ionic strength of all solutions (i.e., standards and samples) is nearly the same (e.g., constant activity coefficients), electrode responses can be related directly to ion concentrations. It is desirable to add a small amount of concentrated salt solution (i.e., ion strength adjuster, ISA), such as NaNO_3 , to all solutions (i.e., both standards and samples) so that the ionic strength of the solutions is dominated by the added salt and becomes approximately the same in all solutions.

When using the pH electrode for pH measurement, a direct reading is produced for the sample pH after the calibration of pH electrode and pH meter with pH buffer solutions (i.e., standards).

3.2 Equipment

The list of equipment associated with pH and/or ion concentration measurements is shown below.

- The electrode(s) (e.g., ORION Model 9635 Ionplus Series Bromide Electrode for iodide concentration measurement). The electrode configuration may consist of two physically separate electrodes or a single probe that contains both the working and reference electrodes.
- A pH/ISE meter. The meter (e.g., ORION portable pH/ISE meter model 290A) may be configured to provide voltage readings or direct concentration readings.
- Ionic strength adjuster, electrode filling solution, and polishing strip (if necessary).
- Devices for transferring known volumes of solutions (e.g., pipettes).

- Stirring and temperature control devices, if applicable. Mechanical or magnetic stirring can be used. Temperature control can be achieved by a variety of methods, such as a water bath, hot plate, or constant temperature room. Both stirring and temperature control are optional and, if used, shall be recorded in the scientific notebook.

The electrode is to be kept immersed in water between usage of short duration (e.g., several days). If the electrode will not be used for several weeks, the electrode may be stored dry by removing filling solution from chamber followed by washing with reagent water.

Labware used in this procedure shall be washed in the appropriate cleaning solution (e.g., LIQUI-NOX phosphate-free liquid detergent), rinsed three times with tap water, rinsed three times with reagent water, and air-dried at room temperature.

3.3 Samples

Liquid samples that require pH and/or ion concentration measurements may be from various sources, including (but not limited to) laboratory and field tracer tests, and any water observed in the field that such analysis will potentially help elucidate flow and transport processes. Samples shall be controlled in accordance with YMP-LBNL-QIP-SII.0.

3.3.1 Sample Name/Bottle Labeling

Samples for pH/ISE measurements shall be collected in the appropriate containers (e.g., high-density polyethylene and/or glass bottles with tight sealing caps) deemed suitable for collection and storage of samples. In general, sample collection process is simply to transfer some volumes of sample from the sample source. Care shall be taken (e.g., wear gloves) to prevent cross-contamination during sample collection. For samples to be measured the pH value, they shall be collected, if possible, with minimal headspace inside the collection bottles to minimize potential pH change during the sample transfer period. Each sample shall be given a unique identifier to reflect the sample source or an appropriate abbreviation thereof. Sample names shall be marked with an indelible marker either directly on the bottle or on an adhesive sticker affixed to the bottle along with the name of the originator and the date. The sample name, time and location of sample collection, collection method, and the unique identifier assigned by the YMP Sample Management Facility (SMF) (applicable if the sample is collected in the field site, in accordance with YAP-SII.1Q *Submittal, Review, and Approval of Requests for Yucca Mountain Site Characterization Project Geologic Specimens*) shall be entered into the scientific notebook.

Safety considerations associated with handling of chemicals will depend on the chemical nature of the constituents in the solutions. Material Safety

Data Sheets (MSDSs) shall be consulted to determine whether special protective clothing and/or eye protection are required. A hazard label shall be placed on any sample bottle that contains hazardous chemicals.

3.3.2 Sample Handling/Preservation

For samples collected from the laboratory work, they shall be refrigerated before analysis. For samples collected from field sites, refrigeration after sample collection and during sample transfer to LBNL may not be feasible. Dependent upon the characteristics of the samples, alternative steps (e.g., as putting the ice packs together with the samples during sample storage and transfer) shall be taken, at the discretion of the responsible PI or designee, to mitigate potential sample degradation. The method of preservation shall be recorded in the scientific notebook.

If samples are collected from field sites, a qualitative pH measurement may be conducted immediately after the sample collection by using pH indicator strips. For example, EM Science ColorpHast strips provide accurate colorimetric pH indication. The Narrow Range strips (e.g., pH 4.0-7.0, 6.5-10.0, and 11.0-13.0) can provide a sensitivity of 0.2-0.3 pH units. Measurement of pH is conducted by immersing the strips in samples and comparing the resultant color to the Color Chart provided. The results shall be recorded in the scientific notebook. After the samples are received at LBNL, pH measurement shall be conducted at the first available opportunity in accordance with Section 3.4., and the qualitative pH value from the pH indicator strips (if available) is compared to the pH obtained from a calibrated pH meter in accordance with Section 3.4.

For ISE measurements, with the above stated sample handling requirements, samples shall be analyzed within three months of collection. If samples cannot be analyzed within this timeframe, they shall be analyzed at the first available opportunity, and a notation shall be placed in the scientific notebook identifying the duration (obtained from sample collection date recorded on the collection bottle, and the analysis date) samples have exceeded the analysis timeframe. An analysis of the data applicability shall be documented in the scientific notebook.

3.4 Implementing Procedure

3.4.1 Identification of Standards to be Used

In accordance with YAP-12.3Q, the Measuring and Test Equipment (M&TE) Justification form (Attachment 1) shall be filled out for each standard and filed in the scientific notebook.

The calibration standards, when available, shall be traceable to nationally recognized standards [e.g., National Institute of Standards and

Technology (NIST)], and procured from YMP-approved contractors on the Qualified Suppliers List (QSL), or an alternative approach within an Activity Evaluation shall be pursued according to AP-2.21Q, *Quality Determinations and Planning for Scientific, Engineering and Regulatory Compliance Activities*.

- A. For pH measurements, prepared buffers accurate to 0.01 pH units or better with NIST traceability are required. Certificates of Analysis showing the comparison between the lot and the primary NIST standard shall be attached to the scientific notebook.
- B. For ISE measurements, NIST-traceable standards may not be available or cannot be obtained within the holding time of necessary measurement. In such cases, high-purity chemicals, such as reagent grade chemicals that conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society (ACS) (American Chemical Society Specifications, 8th edition, 1993), shall be used as the "standards" and the ratio approach described below will be used. Verification of purity shall be demonstrated by a certificate of analysis (e.g., provided on the chemical bottle) supplied by the manufacturer or vendor.

Approaches using ratios shall be employed to present the qualified data when NIST-traceable standards are not available. Such approaches are most appropriate to the laboratory and/or field tracer tests, where relative comparison may be sufficient. For example, the measured instrument response of the collected sample is divided by the response of the released tracer sample, with the instrument responses obtained using the "standards" (see Section 3.4.2 for preparation of "standards"). In employing this ratio approach, the chemicals used for the released samples (therefore, the collected samples) in the tracer tests and used for making "standards" shall be from the same chemical source (e.g., the same bottle).

With the ratio approach, the results are independent of the purity (as well as sources), of chemicals used. Such approaches will limit the applicability of data, however, as only the relative comparison (i.e., the ratio value, instead of the absolute amount/concentration of the analyte) is obtained. Such approach, if used, shall be documented in the scientific notebook.

If NIST-traceable standards become available and can be obtained within the holding time of the samples, comparison runs shall be performed between the non-NIST-traceable and the NIST-traceable standards, with explanation of these results and acceptability of results described in the scientific notebook. If the non-NIST-traceable "standards" are acceptable, the absolute amount/concentration of the

analyte generated based on such "standards" will be regarded as being qualified.

3.4.2 Preparation of ISE Standard Solutions

- A. Standard solutions shall either (1) be NIST-traceable liquid stock solutions obtained from the manufacturer or vendor (see Section 3.4.1) or (2) be prepared using chemicals (see Section 3.4.1B), a calibrated analytical balance, and calibrated volumetric glassware (discussed after in this section).

To obtain the starting standard solution(s), weigh an amount of chemical and dissolve it in a known amount of water. Usually, concentrations of 1,000 mg/L and/or 100 mg/L for the standards are the good working starting solutions. When weighing the amount of chemical standard, avoid using small weights close to the balance precision. Record the chemical weight and liquid volume in the scientific notebook.

Calibrate the balance in accordance to YMP-LBNL-TIP/AFT-1.0, *Balance Calibration*. Verify the accuracy of volumetric flasks, pipettes and pipettors by weighing water quantities delivered (pipettes, pipettors) or contained (flasks) using a calibrated balance. Discard flasks, pipettes and pipettors that show larger than 1% of its nominal volume.

- B. Use serial dilution technique, a widely recognized and accepted method of preparing standards, to obtain a set of standard solutions that span the expected range of concentrations in the samples or the instrument response. For each dilution step, use the pipette and/or pipettor to take the appropriate volume of concentrated stock solution into a volumetric flask and fill the water to the calibration line of the flask. Mix the solution thoroughly. Repeat the dilution step until the desired concentration is obtained. For example, pipet 10 ml of 100 mg/L stock solution into a 100 ml volumetric flask and fill with water to the flask to produce the 10 mg/L standard solution.

Record in the scientific notebook steps taken to make serial dilution, i.e., the volume pipetted and size of volumetric flasks.

- C. Prepare a label indicating the chemical's name and concentration, preparation date, preparer's initial, and attach the label to the individual container of standard solutions.

3.4.3 Preparatory Verification

Add the electrode filling solution to the chamber of the electrode (e.g., use ORION Optimum Results™ D Reference Electrode Filling Solution for ORION Model 9635 Ionplus Series Bromide Electrode); the level of filling

solution shall always be above the electrode sensor and at least one inch above the sample level on immersion to ensure a proper flow rate (which will produce results with a faster response and better stability). The filling solution completes the electrical circuit between the sample and electrode.

For ISE measurements, verify the performances of the electrodes and the meter by obtaining voltage readings for two standard solutions that differ in ion concentration by a factor of 10. Adjust the ionic strength for these standard solutions before the measurement (see Section 3.4.4.B.1). The two readings should differ by $(60 \pm 5)/n$ millivolts where n is the valence of the ion being measured (the exact difference will depend on the temperature). If this is not the case, check or remake the standard solutions. If the problem persists, dispose of the electrode. If the electrode is solid state and the response is sluggish (i.e., need more than 5 minutes to produce a stable result), polish the electrode tip with aluminum oxide polishing strips and then immerse it in the most concentrated standard solution for about 5 minutes and repeat verification.

3.4.4 Calibration and Sample Measurement Method

A. Measurement of pH

Perform pH meter calibration by placing the pH electrode in a particular buffer standard (discussed in Section 3.4.1) and adjusting the meter indication to match the pH of the buffer. Use multiple buffer standards (e.g., pH 4, 7, and 10) to bracket the range of pH values expected of the samples. Conduct sample measurements after the calibration and record the meter indication in the scientific notebook about every 30 seconds until a stable reading is obtained. At the end of sample measurements and/or every two hours after calibration, verify the potential drift of pH electrode/meter by measuring the pH values of the buffer standards. Record the verification results in the scientific notebook.

B. ISE Measurements

For all ISE measurements including both standard solutions and samples, the readings (e.g., the electrode potential values) shall be recorded in the scientific notebook about every 30 seconds until a stable reading is obtained.

(1) Solution Preparation for ISE Measurement

Pipet a volume of solution (i.e., reagent water, standard solution, or sample) into a clean glass vessel (e.g., glass tubes, glass beakers, etc). The volume pipetted out depends upon the availability of the sample volume. It is important that the liquid volume in the glass vessel shall be sufficient enough to cover the electrode sensor. If sample volume is sufficient, pipet 50 ml of solution into a small-

sized beaker; otherwise, pipet a smaller volume (e.g., 5 ml) into a glass tube. Record the volume used in the scientific notebook. Refer to Section 3.2 for labware cleaning. Add a corresponding volume of ISA (see Section 3.1) into the vessel, with the same volume ratio of solution to ISA (e.g., 50:1) for every sample. Mix the solution thoroughly by hand-shaking the glass vessel for a minute or by placing the vessel on the mixer (e.g., nominally for 15 seconds at a speed of 1,400 rpm).

(2) Calibration

Before sample measurements, obtain the responses for a series of standard solutions (refer to Section 3.4.2) to establish a calibration curve. Place the electrode in the reagent water first and record the electrode potential value, and then the least concentrated standard solution. Wait for the reading to stabilize to record, which might take a few minutes for the reagent water and solutions of low tracer concentration. Between measurements, rinse the electrode with reagent water and blot it dry with Kimwipes to avoid solution carryover from sample to sample.

Continue measuring and recording results for standard solutions of increasing concentration until the expected aqueous sample concentration range is spanned. It is necessary to have at least five points (known concentration vs. measured electrode potential) to determine the linear calibration curve (which usually cover several orders of magnitude of concentrations). Electrode potential values in log scale are in linear relationship to the constituent concentration.

To check for electrode drift over time, repeat calibrations at the end of sample measurements (or approximately every two hours during a series of measurements). Record the time and electrode potential value of the calibration in the scientific notebook. If drift occurs, establish a new calibration curve and use it for subsequent measurements. If the drift exceeds 10 mV (except for a very low concentration standard), repeat the measurements since the last calibration.

NOTE: The amount of electrode drift that constitutes a significant error can vary considerably depending on the application, the ion being analyzed, the solution composition, and the environmental conditions. Generally, a drift of 1 mV constitutes approximately a 4% error for a monovalent ion, and the error becomes larger as ion valence increases.

(3) Sample Measurement

Once a calibration curve has been established, proceed the sample measurement by placing the electrode in the sample and recording the electrode potential values in the scientific notebook. Rinse and dry the electrode between samples as described in Section 3.4.4.B.2. Depending upon the constituent concentration present in the samples, dilute the samples appropriately until the final solution measurement falls within the range of the calibration curve. Record the dilution information, if applicable, in the scientific notebook.

(4) General Considerations

Instrument Drift: Calibrations shall be conducted at the beginning and end of sample measurements, and verified approximately once every two hours during a series of measurements to check for instrument drift. Record the results of all calibrations and the times at which they are conducted in the scientific notebook. If significant drift occurs between calibrations, the PI or TIP user must decide whether it is necessary to repeat the measurements made since the last calibration. In general, a drift of more than 5% in the voltage is considered excessive, and serious consideration shall be given to repeating measurements. The decision of whether or not to repeat measurements, and the rationale for it shall be documented in the scientific notebook.

If there is insufficient sample to repeat measurements, it may be necessary to account for drift by averaging or interpolating between two successive calibration curves that bracket the measurements by assuming that the drift is linear with time (or sample analysis sequence). For example, if a standard has readings of -50.0 mV and -55.0 mV before and after a sample is measured, and the sample is the 4th of 10 samples measured between these two standards, then the standard reading to calculate the sample concentration will be $-50.0 + (4/10) [-55.0 - (-50.0)] = -52.0$ mV. Document any correction procedure used in the scientific notebook.

Environmental Conditions: Measurements are the most consistent and reproducible when samples and standards are stirred at a constant rate and kept at a constant temperature. However, it may not be practical to achieve these conditions, particularly if the samples are small. The user shall record the stirring and temperature conditions for the measurement in the scientific notebook. If all the solutions (standards and samples) cannot be kept at a constant temperature, they shall at least be allowed to achieve the same temperature (e.g., room temperature) before the measurements.

NOTE: Some pH/voltmeters come with temperature compensating

features that allow consistent readings to be obtained even when sample temperatures are not constant. Temperature compensation can be achieved by using a temperature probe connected to the meter or by manually specifying the temperature of each sample. The user shall document the use of any of these features. Whenever possible, however, measurements shall be made on samples and standards of uniform temperature.

Stirring: During measurements, avoid direct contact between stirrers and electrode tips. If a magnetic stirrer is used, place a layer of insulating material such as styrofoam between the sample container and the stirring plate to minimize heat transfer from the stirrer motor to the sample.

Measurement Precision: This is accomplished by repeating measurements on a given solution (standard or sample) at least three times over the course of all measurements so that a statistical measure of precision (e.g., standard deviation) can be estimated.

Electrode Response: It is important that the electrode response be allowed to stabilize. Response time is typically longer in more dilute solutions and can also depend on background ions. If the response of a solid-state electrode becomes noticeably more sluggish with time, the tip should be polished as described in Section 3.4.3. The ISE shall be recalibrated after polishing.

3.4.5 Documentation of Sample Measurement Results

The following information shall be recorded in the scientific notebook:

- a) unique identifier of equipments used for the measurements,
- b) unique identifier of samples,
- c) temperature and stirring conditions, if appropriate, of samples at times of measurement,
- d) pH standards used and pH indications for the samples,
- e) for ISE measurements, any special sample preparation, such as ionic strength adjustment, and
- f) for ISE measurements, measurements of electrode response associated with calibration standards and samples.

3.4.6 Identification of Calibration Intervals

Calibration shall be performed each day samples are analyzed (Section 3.4.3). Calibration shall be verified every two hours and at the completion of measurements.

3.4.7 Identification of Tolerances and Ranges of Use

Calibration standards shall be used to define the tolerances and range of use for M&TE covered by this TIP. For pH measurement, the tolerance shall be the tolerance of the buffer solutions used. For ISEs, the correlation coefficient (R^2) value of the calibration curve (log scale of electrode potential values vs. the concentrations) shall define the tolerance. In order for the calibration curve to be acceptable, the R^2 must be equal to or greater than 0.998.

3.4.8 M&TE Storage and Handling

M&TE shall not be handled in a manner that adversely affects its current or future performance. M&TE shall be used in laboratory environments, and stored at room temperature. The electrodes shall not be used to vigorously stir solutions.

3.4.9 Calibration Documentation

In accordance with YAP-12.3Q, staff members shall document the M&TE calibration on the M&TE Calibration Documentation Form (Attachment 2).

Calibration is required each day samples are analyzed, and calibration is an integral part of the measurement procedure. A calibration sticker containing the following information shall be affixed to the pH electrode or ISE or the box that contains the electrode.

<p style="text-align: center;">Calibration</p> <p>By: LBNL staff following the TIP for calibration.</p> <p>This instrument shall be calibrated each day samples are analyzed.</p> <p>Instrument S/N:</p>

Copies of the calibration results shall be provided to the LBNL M&TE Custodian to update the M&TE list as per YAP-12.3Q.

3.4.10 Controls for Out-of-Calibration Conditions

If any out-of-calibration conditions (as described in YAP-12.3Q) are determined to exist for the M&TE item (e.g., instrument produces results

known to be in error), the instrument shall have an out-of-service tag applied indicating that it is not to be used and, when possible, the instrument shall be moved to a segregated "out-of-service" area.

The above conditions shall be documented by using the M&TE Out of Calibration Report (OCR) in accordance with the instructions provided in YAP-12.3Q. If it is determined that the data are impacted, a Nonconformance Report (NCR) shall be initiated in accordance with YAP-15.1Q, *Control of Nonconformances*.

3.4.11 Recalibration When Updates to Software Contained Affects Calibration

All software contained in M&TE is an integral part of the M&TE. Software updates will not affect the previous calibrations as calibration is required each day samples are analyzed.

3.4.12 Usage of M&TE

Staff Members shall document each usage of the equipment in the scientific notebook (containing the same information as described in YAP-12.3Q), or the M&TE Standard Usage Log as described in YAP-12.3Q and file the Usage Log in the Equipment Logbook or scientific notebook).

3.5 Potential Sources of Error and Uncertainty

The following sources of error and uncertainty may exist:

- temperature or stirring differences between samples,
- electrode drift between calibrations,
- reading the electrode response before it has stabilized (due to slow response),
- poor preparation of standards used for calibration (for ISE measurements),
- for ISE measurements, presence of interfering ions (i.e., ions that give an electrode response or that form complexes with the ion being measured) in the samples that are not present in the calibration standards, and
- for ISE measurements, failure to adjust all solutions to approximately the same ionic strength, or failure to correct for ionic strength differences.

4. RECORDS

4.1 Lifetime

Records generated as a result of this TIP are entries in:

- Scientific notebooks or attachments to such notebooks,
- Equipment Logbooks (including M&TE Standard Usage Log, if applicable) controlled as supplemental records to the scientific notebook,
- M&TE Out of Calibration Reports, if applicable.

4.2 Non-Permanent

None

4.3 Controlled Documents

This Technical Implementing Procedure

4.4 Records Center Documents

Records associated with this procedure shall be submitted to the Records Coordinator for submittal to the Records Processing Center (RPC) in accordance with AP-17.1Q, *Record Source Responsibility for Inclusionary Records*.

5. RESPONSIBILITIES

5.1 The **Principal Investigator (PI)** is responsible for assuring full compliance with this procedure and providing training thereof. The PI is responsible for overseeing and coordinating the preparation, review, distribution, revision, and recommending rescission of the TIP.

5.2 **Staff Members** are responsible for following this procedure and turning over related documentation to the Records Coordinator for submittal to the RPC in accordance with AP-17.1Q. Related data shall be turned over to Technical Data Coordinator for entry into the YMP Technical Database Management System (TDMS) in accordance with YMP-LBNL-QIP-SIII.3, *Submitting Key Data to the Yucca Mountain Project Office*.

6. ACRONYMS AND DEFINITIONS

6.1 Acronyms

ACS	American Chemical Society
AFT	Ambient Field Testing
AP	OCRWM Administrative Procedure

EA	Engineering Assurance
ISA	Ionic Strength Adjuster
ISE	Ion Selective Electrode
LBNL	Lawrence Berkeley National Laboratory
M&TE	Measuring and Test Equipment
MSDS	Material Safety Data Sheet
NCR	Nonconformance Report
NIST	National Institute of Standards and Technology
OCR	Out of Calibration Report
OCRWM	Office of Civilian Radioactive Waste Management
OQA	Office of Quality Assurance
PI	Principal Investigator
QARD	Quality Assurance Requirements and Description
QIP	Quality Implementing Procedure
RPC	Records Processing Center
SMF	Sample Management Facility
TIP	Technical Implementing Procedure
TDMS	Technical Data Management System
YAP	YMP Administrative Procedure
YMP	Yucca Mountain Site Characterization Project

6.2 Definitions

Staff Member: Any scientist, engineer, research or technical associate, technician, or student research assistant performing quality-affecting work for YMP-LBNL.

Technical Implementing Procedure: Each TIP describes YMP-LBNL technical tasks that (1) are repetitive, and (2) are standardized.

7. REFERENCES

AP-2.21Q, *Quality Determinations and Planning for Scientific, Engineering and Regulatory Compliance Activities*

AP-17.1Q, *Record Source Responsibility for Inclusionary Records*

AP-SIII.1Q, *Scientific Notebooks*

AP-SIII.3Q, *Submittal and Incorporation of Data to the Technical Data Management System*

DOE/RW-0333P, *Quality Assurance Requirements and Description*

Reagent Chemicals: American Chemical Society Specifications. 8th edition, official from April 1, 1993. American Chemical Society, Washington, DC, 1993.

YAP-12.3Q, *Control of Measuring and Test Equipment and Calibration Standards*

YAP-15.1Q, *Control of Nonconformances*

YAP-SII.1Q, *Submittal, Review, and Approval of Requests for Yucca Mountain Site Characterization Project Geologic Specimens*

YMP-LBNL-QIP-5.2, *Preparing Development Plans & Quality/Technical Implementing Procedures*

YMP-LBNL-QIP-SII.0, *Documenting Sample Control*

YMP-LBNL-TIP/AFT-1.0, *Balance Calibration*

8. ATTACHMENTS

Attachment 1: M&TE Justification Form.

Attachment 2: M&TE Calibration Documentation Form.

9. REVISION HISTORY

09/30/98 - Revision 0, Modification 0:

This TIP was initially a part of scientific notebook procedure/methodology prepared by QinHong (Max) Hu on 06/04/98, and documented in the scientific notebook YMP-LBNL-JSW-QH-1A.

08/18/00 – Revision 1, Modification 0:

Revised the procedure to meet YAP-12.3Q requirements and incorporate references to other applicable APs and YAPs. Added pH measurements in the procedure.

10. APPROVAL

Signature on file

Preparer: Qinhong (Max) Hu

Date:

Signature on file

Technical Review: Timothy J. Kneafsey

Date:

Signature on file

Technical Review: Peter Persoff

Date:

Signature on file

EA Reviewer: Vivi Fissekidou

Date:

Signature on file

OOA Concurrence: Stephen Harris

Date:

Signature on file

Principal Investigator: Joseph S.Y. Wang

Date:

Signature on file

Project Manager: Gudmundur S. Bodvarsson

Date:

YMP-335-R0 07/30/1999	YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT MEASURING AND TEST EQUIPMENT JUSTIFICATION		QA: Page:____ Of:____
1. M&TE ID No.:		2. M&TE Type:	
3. Initiator Name:		4. Date:	5. Responsible Manager or Principle Investigator:
6. Justification:			
7. Approved By: Responsible Manager or Principle Investigator: _____ Date: _____ Printed Name _____ Signature			

M&TE Calibration Documentation Form

a) M&TE description	b) M&TE unique identification	c) Calibration date and time (if applicable)
d) Person performing calibrations		e) M&TE condition (as-found) Working _____ Not working _____
f) Calibration procedure (including revision level)		g) Calibration standards used
h) Location of calibration data YMP-LBNL-_____ Page(s): _____		i) Location of calibration results YMP-LBNL-_____ Page(s): _____
j) Specified range and tolerances		
k) Statement of acceptability including acceptability of range and tolerances Range acceptable Yes _____, No _____ Tolerance acceptable Yes _____, No _____ Calibration acceptable Yes _____, No _____ Comments:		
l) Re-calibration due date or calibration interval/frequency		m) Reference to actions taken with out-of-calibration or non conforming M&TE, including evaluation results, as appropriate YMP-LBNL-_____ Page(s): _____
n) Comments		

Signature

Date